AN 2000:37783 HCAPLUS
DN 132:96561
TI Lead-free solders
IN Matsumoto, Kazuo; Muraoka, Naoki; Omoto, Takahiko; Ozaki, Masakazu
PA Ishikawa Kinzoku K. K., Japan
SO Jpn. Kokai Tokkyo Koho, 17 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2000015476	A2	20000118	JP 1998-182070	19980629
PRAI	JP 1998-182070		19980629		

AB **Sn** alloys containing Ag 0.5-3.5, Bi 0.5-10.0, Cu 0.1-1.0, **P** 0.001-0.01 weight% and microalloyed with (a) **Ni** 0.001-0.01, (b) **Ge** 0.005-0.05, (c) Te 0.001-0.01 and **Ga** 0.01-0.1, or (d) **Co** 0.001-0.01 and/or Cr 0.005-0.05 weight% are claimed as solders. The solders are especially useful for accurate mounting of semiconductor chips, etc. on circuit substrates.

0.5-3.5 Ag
0.001-0.01 Ni
0.001-0.01 Co
0.001-0.01 P
0.005-0.05 Ge
0.01-0.1 Ga

Sn

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-015476

(43)Date of publication of application : 18.01.2000

(51)Int.Cl.
B23K 35/26
C22C 13/00
C22C 13/02
H05K 3/34

(21)Application number : 10-182070

(22)Date of filing : 29.06.1998

(71)Applicant : ISHIKAWA KINZOKU KK

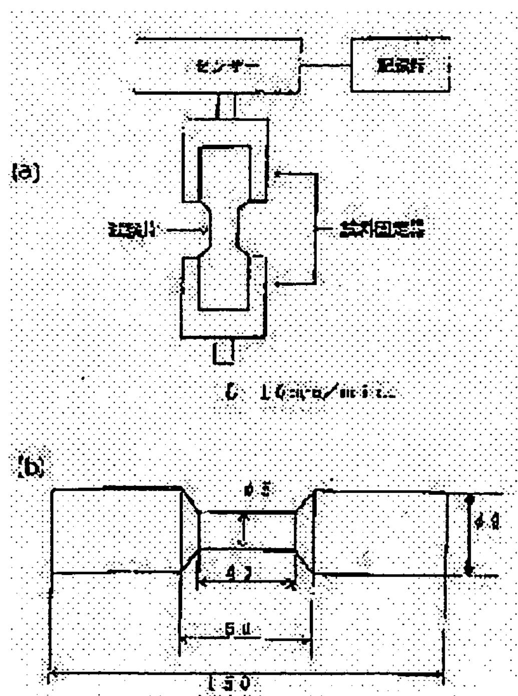
(72)Inventor : MATSUMOTO TOSHIO
MURAOKA NAOKI
OMOTO TAKAHIKO
OZAKI JINICHI

(54) LEAD-FREE SOLDER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a lead-free solder which is less different from a conventional solder in melting point, wettability and mechanical strength, and whose composition elements can be stably and globally supplied, and available from the cost aspect.

SOLUTION: A publicly known lead-free solder alloy having the composition consisting of, by mass, 0.5-3.5% Ag, 0.1-1.0% Cu, 0.5-10.0% Bi, and the balance Sn, is hard and brittle, and weak in its mechanical strength. To reinforce its disadvantages, 0.001-0.01% P, and 0.001-0.01% Ni are added to the alloy to improve the mechanical strength.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, nickel 0.001 - 0.01 mass %, and Sn.
[Claim 2] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, germanium 0.005 - 0.05 mass %, and Sn.
[Claim 3] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Te 0.001 - 0.01 mass %, Ga 0.01 - 0.1 mass %, and Sn.
[Claim 4] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Co 0.001 - 0.01 mass %, and Sn.
[Claim 5] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, and Sn.
[Claim 6] The solder in which a presentation contains Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, Co 0.001 - 0.01 mass %, and Sn.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Since a small chip and semi-conductor components are mounted with a sufficient precision on the circuit board of electronic equipment or an electrical machinery device, this invention relates to the unleaded solder mainly used.
[0002]
[Description of the Prior Art] Since, as for unleaded solder, the lead currently used with the conventional solder has toxicity, the environmental pollution by those industrial waste has been regarded as questionable now. So, although the demand in consideration of such an environmental side of unleaded solder is increasing, since unleaded solder is using Sn (tin) as the principal component, compared with the conventional solder, the melting point becomes high, wettability is also inferior in it a little, and, generally the inclination for a mechanical strength to become low is mainly accepted.
[0003]
[Problem(s) to be Solved by the Invention] In addition to this, the conventional unleaded solder adds elements, such as Zn, In, Sb, and Bi, for Sn as a principal component, and supplements with high-melting [which is a fault], poor wettability, and a mechanical-strength fall.
[0004] However, each element has merits and demerits, for example, wettability also worsens that Zn tends to receive oxidation in atmospheric air. Sb is an element which has some toxicity, quantity of output has a problem in supply few, and In serves as cost quantity. Moreover, Bi makes the eutectic presentation (melting point: 138 degrees C) of Sn-Bi, and is weak against heat and an impact.
[0005]
[Means for Solving the Problem] The unleaded solder of this invention selected Sn-Ag-Cu-Bi which does not have toxicity and is excellent also in adequate supply nature as a basic presentation in order to solve the above-mentioned technical problem. And the 1st invention of this application - the 6th invention add the following presentations in the above-mentioned basic configuration, and are constituted.
[0006] The 1st invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, nickel 0.001 - 0.01 mass %, and the solder containing Sn. The 2nd invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, germanium 0.005 - 0.05 mass %, and the solder containing Sn. The 3rd invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Te 0.001 - 0.01 mass %, Ga 0.01 - 0.1 mass %, and the solder containing Sn.
[0007] The 4th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Co 0.001 - 0.01 mass %, and the solder containing Sn.
[0008] The 5th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, and the solder containing Sn. The 6th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, Co 0.001 - 0.01 mass %, and the solder containing Sn.

[0009] In the solder presentation of the 1st invention, addition of Ag is effective in improving a fall and mechanical property of melting temperature. However, under 0.5 mass % of the effectiveness is inadequate, and on the other hand, by 3.5 mass % **, Ag addition causes a rise and cost quantity of melting temperature, and cannot expect the effectiveness. Since the effectiveness that Ag addition improves a fall and mechanical property of melting temperature in 2.5 mass % from 1.5 mass % is seen, it is the most desirable.
[0010] Addition of Bi lowers the melting temperature of solder, prevents the thermal damage on components or a printed circuit board, and is effective in improving the mechanical property after soldering further. However, under by 0.5 mass %, the effectiveness has inadequate Bi addition and, on the other hand, it becomes it is hard and weak at 10.0 mass % **.
[0011] Addition of Cu makes an organization make it detailed more, and is effective in improving a mechanical property further. However, under 0.1 mass % of the effectiveness is [Cu addition] inadequate, and, on the other hand, it reduces a mechanical property by the rise of melting temperature, and big and rough-ization of the crystalline structure by 1.0 mass % **. Since the effectiveness that Cu addition makes an organization make it detailed more in 0.8 mass % from 0.5 mass %, and improves a mechanical property further is seen, it is the most desirable.
[0012] Addition of P is effective in improving antioxidizing and a mechanical property. However, under 0.001 mass % of the effectiveness is [P addition] inadequate, and, on the other hand, it reduces a mechanical property by 0.01 mass % **. Since the effectiveness that P addition improves the antioxidizing effectiveness and a mechanical property in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0013] Although nickel addition makes a solder organization make it detailed more and a mechanical property is made to improve further, under 0.001 mass % of the effectiveness is [nickel addition] inadequate, and, on the other hand, it skyrockets melting temperature by 0.01 mass % **. Since the effectiveness that nickel addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0014] In the solder presentation of the 2nd invention, although germanium addition makes a solder organization make it detailed more and a mechanical property is made to improve further, under 0.005 mass % of the effectiveness is [germanium addition] inadequate, and, on the other hand, it skyrockets melting temperature by 0.05 mass % **. Since the effectiveness that germanium addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.008 to 0.012 mass % is seen, it is the most desirable.
[0015] Having added Te and Ga aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more, and antioxidizing in the solder presentation of the 3rd invention. However, under 0.001 mass % of the effectiveness is [Te addition] inadequate, and, on the other hand, melting temperature rises by 0.001 mass % **. Under 0.01 mass % of the effectiveness is [Ga addition] inadequate, and, on the other hand, melting temperature rises by 0.1 mass % **. In 0.001 to 0.005 mass %, since make a solder organization make it detailed more, a mechanical property is made to improve further and the antioxidizing effectiveness is also seen, Te addition is the most desirable. In 0.01 to 0.05 mass %, since make a solder organization make it detailed more, a mechanical property is made to improve further and the antioxidizing effectiveness is also seen, Ga addition is the most desirable.
[0016] Having added Co aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more in the solder presentation of the 4th invention. However, under 0.001 mass % of the effectiveness is [Co addition] inadequate, and, on the other hand, melting temperature rises by 0.01 mass % **. Since the effectiveness that Co addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0017] Having added Cr aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more in the solder presentation of the 5th invention. However, under 0.005 mass % of the effectiveness is [Cr addition] inadequate, and, on the other hand, melting temperature rises by

0.05 mass % **. Since the effectiveness that Cr addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.01 to 0.02 mass % is seen, it is the most desirable.
[0018] In the solder presentation of the 6th invention, having added Co further to the solder presentation of the 5th invention aims at heightening more the effectiveness which makes detailed the solder organization which Cr has, and the effectiveness which a mechanical property improves. However, under 0.001 mass % of the effectiveness is [Co addition] inadequate, and, on the other hand, melting temperature rises by 0.01 mass % **. Since the effectiveness that Co addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0019]
[Embodiment of the Invention] As an example, Table 1 (example No.1-01-1-24), Table 2 (example No.2-01-2-24), The solder of the presentation shown in Table 3 (example No.3-01-3-24), Table 4 (example No.4-01-4-24), Table 5 (example No.5-01-5-24), and Table 6 (example No.6-01-6-24) was manufactured.
[0020] The figure which shows the presentation rate in Table 6 from Table 1 shows mass %, and melting temperature shows (solidus-line temperature - liquidus-line temperature).
[0021]
[Table 1]

表1. 実施例

No.	Sn	Ag	Bi	Cu	P	Ni	溶融温度℃
1-01	残部	0.5	0.5	0.1	0.001	0.001	217 ~232
1-02	残部	0.5	1.0	0.1	0.001	0.001	212 ~227
1-03	残部	0.5	2.0	0.1	0.001	0.001	209 ~222
1-04	残部	0.5	5.0	0.1	0.001	0.001	201 ~218
1-05	残部	0.5	8.0	0.1	0.001	0.001	192 ~214
1-06	残部	0.5	10.0	0.1	0.001	0.001	178 ~206
1-07	残部	1.0	0.5	0.4	0.004	0.004	218 ~232
1-08	残部	1.0	1.0	0.4	0.004	0.004	213 ~227
1-09	残部	1.0	2.0	0.4	0.004	0.004	210 ~222
1-10	残部	1.0	5.0	0.4	0.004	0.004	203 ~218
1-11	残部	1.0	8.0	0.4	0.004	0.004	194 ~214
1-12	残部	1.0	10.0	0.4	0.004	0.004	178 ~208
1-13	残部	2.0	0.5	0.6	0.006	0.006	218 ~232
1-14	残部	2.0	1.0	0.6	0.006	0.006	214 ~227
1-15	残部	2.0	2.0	0.6	0.006	0.006	210 ~222
1-16	残部	2.0	5.0	0.6	0.006	0.006	203 ~218
1-17	残部	2.0	8.0	0.6	0.006	0.006	194 ~215
1-18	残部	2.0	10.0	0.6	0.006	0.006	179 ~207
1-19	残部	3.5	0.5	1.0	0.01	0.01	219 ~232
1-20	残部	3.5	1.0	1.0	0.01	0.01	214 ~227
1-21	残部	3.5	2.0	1.0	0.01	0.01	211 ~222
1-22	残部	3.5	5.0	1.0	0.01	0.01	205 ~219
1-23	残部	3.5	8.0	1.0	0.01	0.01	194 ~215
1-24	残部	3.5	10.0	1.0	0.01	0.01	179 ~208

[0022]
[Table 2]

表2. 実施例

No.	Sn	Ag	Bi	Cu	P	Ge	溶融温度℃
2-01	残部	0.5	0.5	0.1	0.001	0.005	217 ～232
2-02	残部	0.5	1.0	0.1	0.001	0.005	212 ～227
2-03	残部	0.5	2.0	0.1	0.001	0.005	209 ～222
2-04	残部	0.5	5.0	0.1	0.001	0.005	201 ～218
2-05	残部	0.5	8.0	0.1	0.001	0.005	192 ～214
2-06	残部	0.5	10.0	0.1	0.001	0.005	178 ～206
2-07	残部	1.0	0.5	0.4	0.004	0.008	218 ～232
2-08	残部	1.0	1.0	0.4	0.004	0.008	213 ～227
2-09	残部	1.0	2.0	0.4	0.004	0.008	210 ～222
2-10	残部	1.0	5.0	0.4	0.004	0.008	203 ～218
2-11	残部	1.0	8.0	0.4	0.004	0.008	194 ～214
2-12	残部	1.0	10.0	0.4	0.004	0.008	178 ～208
2-13	残部	2.0	0.5	0.6	0.006	0.012	218 ～232
2-14	残部	2.0	1.0	0.6	0.006	0.012	215 ～227
2-15	残部	2.0	2.0	0.6	0.006	0.012	210 ～223
2-16	残部	2.0	5.0	0.6	0.006	0.012	204 ～219
2-17	残部	2.0	8.0	0.6	0.006	0.012	194 ～215
2-18	残部	2.0	10.0	0.6	0.006	0.012	179 ～207
2-19	残部	3.5	0.5	1.0	0.01	0.05	219 ～232
2-20	残部	3.5	1.0	1.0	0.01	0.05	215 ～228
2-21	残部	3.5	2.0	1.0	0.01	0.05	211 ～224
2-22	残部	3.5	5.0	1.0	0.01	0.05	205 ～219
2-23	残部	3.5	8.0	1.0	0.01	0.05	194 ～215
2-24	残部	3.5	10.0	1.0	0.01	0.05	179 ～208

[0023]
[Table 3]

表3．実施例

No.	Sn	Ag	Bi	Cu	P	Te	Ga	溶融温度℃
3-01	残部	0.5	0.5	0.1	0.001	0.001	0.01	217 ～232
3-02	残部	0.5	1.0	0.1	0.001	0.001	0.01	212 ～227
3-03	残部	0.5	2.0	0.1	0.001	0.001	0.01	209 ～222
3-04	残部	0.5	5.0	0.1	0.001	0.001	0.01	201 ～218
3-05	残部	0.5	8.0	0.1	0.001	0.001	0.01	192 ～214
3-06	残部	0.5	10.0	0.1	0.001	0.001	0.01	178 ～206
3-07	残部	1.0	0.5	0.4	0.004	0.004	0.04	218 ～232
3-08	残部	1.0	1.0	0.4	0.004	0.004	0.04	213 ～227
3-09	残部	1.0	2.0	0.4	0.004	0.004	0.04	210 ～222
3-10	残部	1.0	5.0	0.4	0.004	0.004	0.04	203 ～218
3-11	残部	1.0	8.0	0.4	0.004	0.004	0.04	194 ～214
3-12	残部	1.0	10.0	0.4	0.004	0.004	0.04	178 ～208
3-13	残部	2.0	0.5	0.6	0.006	0.006	0.06	218 ～232
3-14	残部	2.0	1.0	0.6	0.006	0.006	0.06	215 ～227
3-15	残部	2.0	2.0	0.6	0.006	0.006	0.06	210 ～223
3-16	残部	2.0	5.0	0.6	0.006	0.006	0.06	204 ～219
3-17	残部	2.0	8.0	0.6	0.006	0.006	0.06	194 ～215
3-18	残部	2.0	10.0	0.6	0.006	0.006	0.06	179 ～207
3-19	残部	3.5	0.5	1.0	0.01	0.01	0.1	219 ～232
3-20	残部	3.5	1.0	1.0	0.01	0.01	0.1	215 ～228
3-21	残部	3.5	2.0	1.0	0.01	0.01	0.1	211 ～224
3-22	残部	3.5	5.0	1.0	0.01	0.01	0.1	205 ～219
3-23	残部	3.5	8.0	1.0	0.01	0.01	0.1	194 ～215
3-24	残部	3.5	10.0	1.0	0.01	0.01	0.1	179 ～208

[0024]
[Table 4]

表4. 実施例

No.	Sn	Ag	Bi	Cu	P	Co	溶融温度℃
4-01	残部	0.5	0.5	0.1	0.001	0.001	217 ~232
4-02	残部	0.5	1.0	0.1	0.001	0.001	212 ~227
4-03	残部	0.5	2.0	0.1	0.001	0.001	209 ~222
4-04	残部	0.5	5.0	0.1	0.001	0.001	201 ~218
4-05	残部	0.5	8.0	0.1	0.001	0.001	192 ~214
4-06	残部	0.5	10.0	0.1	0.001	0.001	178 ~206
4-07	残部	1.0	0.5	0.4	0.004	0.004	218 ~232
4-08	残部	1.0	1.0	0.4	0.004	0.004	213 ~227
4-09	残部	1.0	2.0	0.4	0.004	0.004	210 ~222
4-10	残部	1.0	5.0	0.4	0.004	0.004	203 ~218
4-11	残部	1.0	8.0	0.4	0.004	0.004	194 ~214
4-12	残部	1.0	10.0	0.4	0.004	0.004	178 ~208
4-13	残部	2.0	0.5	0.6	0.006	0.006	218 ~232
4-14	残部	2.0	1.0	0.6	0.006	0.006	215 ~227
4-15	残部	2.0	2.0	0.6	0.006	0.006	210 ~223
4-16	残部	2.0	5.0	0.6	0.006	0.006	204 ~219
4-17	残部	2.0	8.0	0.6	0.006	0.006	194 ~215
4-18	残部	2.0	10.0	0.6	0.006	0.006	179 ~207
4-19	残部	3.5	0.5	1.0	0.01	0.01	219 ~232
4-20	残部	3.5	1.0	1.0	0.01	0.01	215 ~228
4-21	残部	3.5	2.0	1.0	0.01	0.01	211 ~224
4-22	残部	3.5	5.0	1.0	0.01	0.01	205 ~219
4-23	残部	3.5	8.0	1.0	0.01	0.01	194 ~215
4-24	残部	3.5	10.0	1.0	0.01	0.01	179 ~208

[0025]
[Table 5]

表5．実施例

No.	Sn	Ag	Bi	Cu	P	Cr	溶融温度℃
5-01	残部	0.5	0.5	0.1	0.001	0.005	217 ～232
5-02	残部	0.5	1.0	0.1	0.001	0.005	212 ～227
5-03	残部	0.5	2.0	0.1	0.001	0.005	209 ～222
5-04	残部	0.5	5.0	0.1	0.001	0.005	201 ～218
5-05	残部	0.5	8.0	0.1	0.001	0.005	192 ～214
5-06	残部	0.5	10.0	0.1	0.001	0.005	178 ～206
5-07	残部	1.0	0.5	0.4	0.004	0.01	218 ～232
5-08	残部	1.0	1.0	0.4	0.004	0.01	213 ～227
5-09	残部	1.0	2.0	0.4	0.004	0.01	210 ～222
5-10	残部	1.0	5.0	0.4	0.004	0.01	203 ～218
5-11	残部	1.0	8.0	0.4	0.004	0.01	194 ～214
5-12	残部	1.0	10.0	0.4	0.004	0.01	178 ～208
5-13	残部	2.0	0.5	0.6	0.006	0.02	218 ～232
5-14	残部	2.0	1.0	0.6	0.006	0.02	215 ～227
5-15	残部	2.0	2.0	0.6	0.006	0.02	210 ～223
5-16	残部	2.0	5.0	0.6	0.006	0.02	204 ～219
5-17	残部	2.0	8.0	0.6	0.006	0.02	194 ～215
5-18	残部	2.0	10.0	0.6	0.006	0.02	179 ～207
5-19	残部	3.5	0.5	1.0	0.01	0.05	219 ～232
5-20	残部	3.5	1.0	1.0	0.01	0.05	215 ～228
5-21	残部	3.5	2.0	1.0	0.01	0.05	211 ～224
5-22	残部	3.5	5.0	1.0	0.01	0.05	205 ～219
5-23	残部	3.5	8.0	1.0	0.01	0.05	194 ～215
5-24	残部	3.5	10.0	1.0	0.01	0.05	179 ～208

[0026]
[Table 6]

表6．実施例

No.	Sn	Ag	Bi	Cu	P	Cr	Co	溶融温度℃
6-01	残部	0.5	0.5	0.1	0.001	0.005	0.001	217 ～232
6-02	残部	0.5	1.0	0.1	0.001	0.005	0.001	212 ～227
6-03	残部	0.5	2.0	0.1	0.001	0.005	0.001	209 ～222
6-04	残部	0.5	5.0	0.1	0.001	0.005	0.001	201 ～218
6-05	残部	0.5	8.0	0.1	0.001	0.005	0.001	192 ～214
6-06	残部	0.5	10.0	0.1	0.001	0.005	0.001	178 ～206
6-07	残部	1.0	0.5	0.4	0.004	0.01	0.004	218 ～232
6-08	残部	1.0	1.0	0.4	0.004	0.01	0.004	213 ～227
6-09	残部	1.0	2.0	0.4	0.004	0.01	0.004	210 ～222
6-10	残部	1.0	5.0	0.4	0.004	0.01	0.004	203 ～218
6-11	残部	1.0	8.0	0.4	0.004	0.01	0.004	194 ～214
6-12	残部	1.0	10.0	0.4	0.004	0.01	0.004	178 ～208
6-13	残部	2.0	0.5	0.6	0.006	0.02	0.006	218 ～232
6-14	残部	2.0	1.0	0.6	0.006	0.02	0.006	215 ～227
6-15	残部	2.0	2.0	0.6	0.006	0.02	0.006	210 ～223
6-16	残部	2.0	5.0	0.6	0.006	0.02	0.006	204 ～218
6-17	残部	2.0	8.0	0.6	0.006	0.02	0.006	194 ～215
6-18	残部	2.0	10.0	0.6	0.006	0.02	0.006	179 ～207
6-19	残部	3.5	0.5	1.0	0.01	0.05	0.01	219 ～232
6-20	残部	3.5	1.0	1.0	0.01	0.05	0.01	215 ～228
6-21	残部	3.5	2.0	1.0	0.01	0.05	0.01	211 ～223
6-22	残部	3.5	5.0	1.0	0.01	0.05	0.01	205 ～218
6-23	残部	3.5	8.0	1.0	0.01	0.05	0.01	194 ～215
6-24	残部	3.5	10.0	1.0	0.01	0.05	0.01	179 ～208

[0027] The solder (example No.of comparison1-5) of the presentation shown in Table 7 was manufactured as an example of a comparison for comparing with the above and an example, and the melting temperature was measured.
[0028]
[Table 7]

表7．比較例

No.	Sn	Ag	Bi	Cu	溶融温度（℃）
1	残部	3.5	—	—	221～229
2	残部	1.5	5.0	—	205～219
3	残部	1.5	—	1.0	217～222
4	残部	1.5	5.0	1.0	201～218
5	残部	2.0	7.5	0.5	177～209

[0029] About the above, the example, and the example of a comparison, it fell at the time of the tensile test at the time of ordinary temperature (measurement 1), the tensile test at the time of an elevated temperature (measurement 2), the creep test (measurement 3) by the fracture timing measurement at the time of ordinary temperature, and an elevated temperature out, and Young's modulus (measurement 5) at the time of timing measurement (measurement 4) and ordinary temperature was measured.
[0030] The measurement result of the example of a comparison is shown in Table 8, and the measurement result of an example is shown in Tables 9-14. in addition, the unit of tensile strength -- the unit of kgf/mm2 and elongation -- the unit of %, fracture time amount, and gradation time amount -- time amount (Hr) and Young's modulus -- kN/mm2 it is .
[0031]
[Table 8]

表8．比較例の測定結果

評価	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
No.	引張強度	伸 び	引張強度	伸 び	破断時間	抜落ち時間	ヤング率
1	6.7	27.4	4.8	25.3	9200以上	6600以上	40.2
2	7.6	15.3	5.3	14.5	9200以上	6600以上	37.8
3	5.5	27.4	3.9	29.4	9200以上	6600以上	41.3
4	8.4	16.7	5.8	15.8	9200以上	6600以上	38.7
5	8.3	13.2	5.5	14.8	8300	6600以上	41.6

[0032]
[Table 9]

表9．実施例NO．1－01～1－24のはんだ合金の特性比較データ

評価 No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
1-01	7.2	16.7	5.7	15.6	9200以上	6600以上	38.2
1-02	7.3	15.3	5.9	14.2	9200以上	6600以上	37.8
1-03	7.7	15.4	6.1	13.8	9200以上	6600以上	37.4
1-04	7.9	14.2	6.4	12.1	9200以上	6600以上	36.7
1-05	8.4	13.8	6.7	11.8	9200以上	6600以上	35.9
1-06	8.8	12.4	6.9	10.2	9200以上	6600以上	35.1
1-07	7.3	16.3	5.9	16.1	9200以上	6600以上	39.0
1-08	7.5	15.7	6.2	15.0	9200以上	6600以上	38.6
1-09	7.8	14.3	6.4	14.1	9200以上	6600以上	37.5
1-10	8.1	13.5	6.6	13.0	9200以上	6600以上	36.7
1-11	8.4	12.6	6.9	12.3	9200以上	6600以上	36.1
1-12	8.9	11.8	7.2	10.9	9200以上	6600以上	35.5
1-13	7.4	15.4	5.8	15.8	9200以上	6600以上	39.1
1-14	7.6	14.7	8.2	14.4	9200以上	6600以上	38.6
1-15	7.8	14.1	6.4	13.5	9200以上	6600以上	37.8
1-16	8.3	13.7	6.9	12.5	9200以上	6600以上	37.1
1-17	8.5	12.2	7.0	11.9	9200以上	6600以上	36.5
1-18	9.2	11.0	7.3	10.4	9200以上	6600以上	36.0
1-19	7.5	15.9	5.5	15.2	9200以上	6600以上	38.4
1-20	7.9	14.3	5.7	14.0	9200以上	6600以上	37.5
1-21	8.4	13.4	5.9	13.3	9200以上	6600以上	37.3
1-22	8.9	12.2	6.0	12.1	9200以上	6600以上	36.6
1-23	9.2	11.8	6.8	11.3	9200以上	6600以上	35.5
1-24	9.5	10.8	7.0	10.2	9200以上	6600以上	35.0

[0033]
[Table 10]

表10. 実施例NO. 2－01～2－24のはんだ合金の特性比較データ

評価	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
No.	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
2-01	7.3	16.6	5.5	15.2	9200以上	6600以上	38.5
2-02	7.5	15.1	5.6	14.0	9200以上	6600以上	37.9
2-03	7.8	14.7	5.9	13.4	9200以上	6600以上	37.3
2-04	8.1	13.9	6.2	11.9	9200以上	6600以上	36.8
2-05	8.6	13.5	6.6	11.6	9200以上	6600以上	35.6
2-06	9.0	12.0	6.8	10.5	9200以上	6600以上	34.9
2-07	7.1	16.5	5.6	15.4	9200以上	6600以上	37.8
2-08	7.3	15.0	6.1	14.0	9200以上	6600以上	36.9
2-09	7.5	14.8	6.3	13.6	9200以上	6600以上	37.0
2-10	8.0	14.1	6.8	11.8	9200以上	6600以上	38.5
2-11	8.3	13.7	7.1	11.2	9200以上	6600以上	36.3
2-12	8.7	12.2	7.3	10.0	9200以上	6600以上	35.6
2-13	7.4	16.4	5.7	15.6	9200以上	6600以上	38.1
2-14	7.7	15.4	5.9	14.2	9200以上	6600以上	37.3
2-15	8.0	14.9	6.1	13.8	9200以上	6600以上	36.8
2-16	7.9	13.7	6.4	12.1	9200以上	6600以上	36.5
2-17	8.5	12.9	6.7	11.8	9200以上	6600以上	36.2
2-18	8.7	11.8	6.9	10.2	9200以上	6600以上	35.4
2-19	7.3	15.9	5.7	15.2	9200以上	6600以上	38.2
2-20	7.6	14.2	5.9	14.4	9200以上	6600以上	37.6
2-21	8.0	13.5	6.1	13.7	9200以上	6600以上	37.3
2-22	8.0	12.2	6.4	12.3	9200以上	6600以上	36.8
2-23	8.7	11.5	6.7	11.2	9200以上	6600以上	36.0
2-24	9.1	10.5	6.9	9.9	9200以上	6600以上	35.3

[0034]
[Table 11]

表11. 実施例NO. 3－01～3－24のはんだ合金の特性比較データ

評価 / No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
3-01	7.1	16.6	5.5	15.3	9200以上	6600以上	38.4
3-02	7.4	15.3	5.8	14.1	9200以上	6600以上	37.6
3-03	7.9	14.6	6.0	12.9	9200以上	6600以上	37.2
3-04	8.2	14.0	6.3	11.8	9200以上	6600以上	36.9
3-05	8.8	13.7	6.9	11.4	9200以上	6600以上	36.1
3-06	9.1	12.2	7.0	10.8	9200以上	6600以上	35.8
3-07	7.0	16.3	5.9	15.2	9200以上	6600以上	37.9
3-08	7.4	14.9	6.2	14.1	9200以上	6600以上	37.4
3-09	7.7	14.6	6.5	13.4	9200以上	6600以上	37.0
3-10	8.1	14.0	6.9	11.7	9200以上	6600以上	36.9
3-11	8.4	13.8	7.1	11.4	9200以上	6600以上	36.0
3-12	8.9	12.3	7.2	10.3	9200以上	6600以上	35.6
3-13	7.6	16.1	5.3	15.4	9200以上	6600以上	38.4
3-14	7.8	15.7	5.6	14.0	9200以上	6600以上	37.9
3-15	8.2	14.9	6.0	13.7	9200以上	6600以上	37.1
3-16	8.3	13.9	6.2	12.0	9200以上	6600以上	36.6
3-17	8.7	13.2	6.6	11.6	9200以上	6600以上	35.9
3-18	9.1	12.1	6.9	10.4	9200以上	6600以上	35.7
3-19	7.1	15.1	5.7	14.7	9200以上	6600以上	37.6
3-20	7.4	14.0	5.9	13.8	9200以上	6600以上	37.1
3-21	7.7	13.3	6.1	12.9	9200以上	6600以上	36.8
3-22	8.1	12.0	6.4	11.5	9200以上	6600以上	35.8
3-23	8.8	11.1	6.7	10.8	9200以上	6600以上	34.9
3-24	9.3	10.0	6.8	9.7	9200以上	6600以上	34.7

[0035]
[Table 12]

表12．実施例NO．4－01～4－24のはんだ合金の特性比較データ

評価 No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
4-01	7.4	16.9	5.2	15.0	9200以上	6600以上	37.9
4-02	7.5	15.0	5.7	13.7	9200以上	6600以上	36.6
4-03	7.8	14.4	6.1	12.6	9200以上	6600以上	36.2
4-04	8.0	13.9	6.5	11.9	9200以上	6600以上	36.0
4-05	8.6	13.6	6.8	11.2	9200以上	6600以上	35.8
4-06	8.8	12.5	7.1	10.7	9200以上	6600以上	35.4
4-07	7.1	16.1	5.6	15.3	9200以上	6600以上	38.1
4-08	7.3	15.7	6.0	14.5	9200以上	6600以上	37.6
4-09	7.8	14.5	6.3	13.0	9200以上	6600以上	37.5
4-10	8.3	13.8	6.7	12.1	9200以上	6600以上	36.9
4-11	8.6	12.7	7.0	11.5	9200以上	6600以上	36.0
4-12	9.1	11.9	7.3	10.1	9200以上	6600以上	35.6
4-13	7.4	16.3	5.2	15.3	9200以上	6600以上	38.0
4-14	7.7	15.5	5.4	14.1	9200以上	6600以上	37.6
4-15	8.3	14.6	5.7	13.9	9200以上	6600以上	37.3
4-16	8.4	13.5	6.0	12.3	9200以上	6600以上	36.9
4-17	8.6	12.8	6.4	11.8	9200以上	6600以上	35.6
4-18	9.0	11.4	6.8	10.2	9200以上	6600以上	35.0
4-19	7.0	15.1	5.5	14.5	9200以上	6600以上	38.6
4-20	7.1	14.3	5.9	13.5	9200以上	6600以上	37.5
4-21	7.4	13.2	6.1	12.7	9200以上	6600以上	37.3
4-22	8.3	11.8	6.2	11.4	9200以上	6600以上	36.6
4-23	8.9	10.3	6.4	10.3	9200以上	6600以上	36.1
4-24	9.2	9.8	6.6	9.8	9200以上	6600以上	35.4

[0036]
[Table 13]

表13. 実施例NO. 5－01～5－24のはんだ合金の特性比較データ

評価 / No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
5-01	7.3	16.8	5.4	15.3	9200以上	6600以上	38.1
5-02	7.4	15.2	5.8	14.1	9200以上	6600以上	37.4
5-03	7.6	14.5	6.1	13.8	9200以上	6600以上	36.9
5-04	7.9	13.7	6.4	12.5	9200以上	6600以上	36.2
5-05	8.3	13.3	7.1	11.4	9200以上	6600以上	35.4
5-06	8.7	12.4	7.4	10.9	9200以上	6600以上	35.2
5-07	7.3	16.3	5.8	15.1	9200以上	6600以上	37.9
5-08	7.5	15.6	6.0	14.3	9200以上	6600以上	37.5
5-09	7.9	14.3	6.2	12.8	9200以上	6600以上	37.3
5-10	8.2	13.6	6.5	12.3	9200以上	6600以上	37.0
5-11	8.5	12.4	6.9	11.2	9200以上	6600以上	36.5
5-12	9.0	11.7	7.2	10.4	9200以上	6600以上	35.8
5-13	7.3	16.0	5.7	15.7	9200以上	6600以上	38.7
5-14	7.6	15.2	6.2	14.0	9200以上	6600以上	37.9
5-15	8.1	14.5	6.7	13.6	9200以上	6600以上	37.4
5-16	8.3	13.4	7.0	12.4	9200以上	6600以上	37.0
5-17	8.8	12.5	7.3	11.6	9200以上	6600以上	36.0
5-18	9.3	11.0	7.7	10.1	9200以上	6600以上	35.3
5-19	7.2	15.3	5.6	14.3	9200以上	6600以上	38.3
5-20	7.3	14.2	6.0	13.4	9200以上	6600以上	37.7
5-21	7.6	13.5	6.2	12.8	9200以上	6600以上	37.4
5-22	8.1	12.0	6.4	11.2	9200以上	6600以上	36.5
5-23	8.4	11.2	6.7	10.6	9200以上	6600以上	36.0
5-24	8.9	9.9	6.8	10.2	9200以上	6600以上	35.6

[0037]
[Table 14]

表14. 実施例NO. 6-01～6-24のはんだ合金の特性比較データ

評価 No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
6-01	7.2	16.6	5.6	15.1	9200以上	6600以上	38.2
6-02	7.5	15.1	5.9	14.3	9200以上	6600以上	37.3
6-03	7.8	14.6	6.2	13.5	9200以上	6600以上	36.8
6-04	8.1	13.6	6.6	12.7	9200以上	6600以上	36.3
6-05	8.5	13.1	7.0	11.8	9200以上	6600以上	35.9
6-06	8.9	12.2	7.2	10.6	9200以上	6600以上	35.5
6-07	7.2	15.9	5.4	15.0	9200以上	6600以上	38.3
6-08	7.7	15.5	5.8	14.7	9200以上	6600以上	37.8
6-09	8.0	14.7	6.1	13.2	9200以上	6600以上	37.3
6-10	8.3	13.9	6.4	12.7	9200以上	6600以上	36.8
6-11	8.4	12.5	6.7	11.5	9200以上	6600以上	36.3
6-12	8.8	11.8	7.0	10.8	9200以上	6600以上	35.7
6-13	7.5	15.9	5.4	15.7	9200以上	6600以上	37.9
6-14	7.7	15.0	5.9	14.3	9200以上	6600以上	37.5
6-15	8.3	14.7	6.4	13.8	9200以上	6600以上	37.4
6-16	8.7	13.6	6.8	12.1	9200以上	6600以上	36.7
6-17	9.1	12.2	7.0	11.8	9200以上	6600以上	35.8
6-18	9.5	10.9	7.4	10.5	9200以上	6600以上	35.3
6-19	7.1	15.3	4.8	14.1	9200以上	6600以上	37.6
6-20	7.5	14.1	5.1	13.0	9200以上	6600以上	36.9
6-21	7.9	13.0	5.5	12.2	9200以上	6600以上	36.4
6-22	8.2	11.6	5.8	11.1	9200以上	6600以上	35.9
6-23	8.6	10.5	6.3	10.4	9200以上	6600以上	35.2
6-24	9.1	9.8	6.8	9.3	9200以上	6600以上	34.7

[0038] The Measuring condition of measurement 1 - measurement 4 is as being shown below.
[0039]
Measurement 1: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Ordinary temperature (25 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: ** tensile strength (Kgf/mm2) ** growth ** (%) Measurement 2: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Elevated temperature (100 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: ** tensile strength (Kgf/mm2) ** growth ** (%) Measurement 3: Equipment: The equipment and the test piece which are shown in drawing 1 Temperature: Ordinary temperature (25 degrees C)
Load: 15kg (7.5N/mm2) [Creep resistance]
Time amount until it evaluates : fractures (Hr.)
Test method: ******** formed like drawing 1 in ordinary temperature (25 degrees C) It is 2 7.5 N/mm to a golden test piece. A load is added and it is to fracture. Time amount was measured.
[0040]
Measurement 4: Equipment: Equipment shown in drawing 2 Temperature: Elevated temperature (100 degrees C)
Load: 1kg [creep resistance]
Evaluation: Time amount until copper wire falls out (Hr.)

Test method: He is one side covellite Dos like drawing 2 at an elevated temperature (100 degrees C). It is 55mg about copper wire with a diameter of 1mm to a roux hole substrate. It solders with solder and is 1Kgf caudad. It is ** about a load. It obtained and the time amount to fracture was measured.
[0041]
Measurement 5: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Ordinary temperature (25 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: It asks for Young's modulus from tensile strength and elongation.
[0042] Elongation was low although, as for the example, the inclination for tensile strength to be high was accepted in the tensile test at the time of ordinary temperature (measurement 1) as compared with the example of a comparison as a result of measurement.
[0043] In the tensile test (measurement 2) at the time of an elevated temperature (100 degrees C), although it was admitted that the tensile strength of an example was fully high to the example of a comparison, elongation was low.
[0044] it was admitted that creep resistance boiled especially the above-mentioned example markedly to the example of a comparison in the creep test (measurement 3) by the fracture timing measurement at the time of ordinary temperature, and it excelled.
[0045] Furthermore, it was admitted that it fell at the time of an elevated temperature out, and the above-mentioned example was extremely excellent in the bonding strength of the soldering section at the time of an elevated temperature to the example of a comparison in a timing measurement trial (measurement 4).
[0046] The solder of this invention is usable also about what can use with the gestalt of a rod, a wire, a ribbon, preforming, solder powder, etc., and contains flux.
[0047]
[Effect of the Invention] According to this invention, the unleaded solder which was excellent in the heat-resistant property and the creep-proof property, and was especially excellent in the bonding strength and tensile strength of the soldering section at the time of an elevated temperature can be offered. And when soldering of precision electronic equipment or the electronic equipment for automobiles is performed using the solder of this invention, reliable soldering which the crack or soldering exfoliation by thermal fatigue do not generate can be performed.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Field of the Invention] Since a small chip and semi-conductor components are mounted with a sufficient precision on the circuit board of electronic equipment or an electrical machinery device, this invention relates to the unleaded solder mainly used.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Since, as for unleaded solder, the lead currently used with the conventional solder has toxicity, the environmental pollution by those industrial waste has been regarded as questionable now. So, although the demand in consideration of such an environmental side of unleaded solder is increasing, since unleaded solder is using Sn (tin) as the principal component, compared with the conventional solder, the melting point becomes high, wettability is also inferior in it a little, and, generally the inclination for a mechanical strength to become low is mainly accepted.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the unleaded solder which was excellent in the heat-resistant property and the creep-proof property, and was especially excellent in the bonding strength and tensile strength of the soldering section at the time of an elevated temperature can be offered. And when soldering of precision electronic equipment or the electronic equipment for automobiles is performed using the solder of this invention, reliable soldering which the crack or soldering exfoliation by thermal fatigue do not generate can be performed.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In addition to this, the conventional unleaded solder adds elements, such as Zn, In, Sb, and Bi, for Sn as a principal component, and supplements with high-melting [which is a fault], poor wettability, and a mechanical-strength fall.
[0004] However, each element has merits and demerits, for example, wettability also worsens that Zn tends to receive oxidation in atmospheric air. Sb is an element which has some toxicity, quantity of output has a problem in supply few, and In serves as cost quantity. Moreover, Bi makes the eutectic presentation (melting point: 138 degrees C) of Sn-Bi, and is weak against heat and an impact.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] The unleaded solder of this invention selected Sn-Ag-Cu-Bi which does not have toxicity and is excellent also in adequate supply nature as a basic presentation in order to solve the above-mentioned technical problem. And the 1st invention of this application - the 6th invention add the following presentations in the above-mentioned basic configuration, and are constituted.
[0006] The 1st invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, nickel 0.001 - 0.01 mass %, and the solder containing Sn. The 2nd invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, germanium 0.005 - 0.05 mass %, and the solder containing Sn. The 3rd invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Te 0.001 - 0.01 mass %, Ga 0.01 - 0.1 mass %, and the solder containing Sn.
[0007] The 4th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Co 0.001 - 0.01 mass %, and the solder containing Sn.
[0008] The 5th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0.5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, and the solder containing Sn. The 6th invention requires a presentation for Ag 0.5 - 3.5 mass %, Bi 0:5 - 10.0 mass %, Cu 0.1 - 1.0 mass %, P0.001 - 0.01 mass %, Cr 0.005 - 0.05 mass %, Co 0.001 - 0.01 mass %, and the solder containing Sn.
[0009] In the solder presentation of the 1st invention, addition of Ag is effective in improving a fall and mechanical property of melting temperature. However, under 0.5 mass % of the effectiveness is inadequate, and on the other hand, by 3.5 mass % **, Ag addition causes a rise and cost quantity of melting temperature, and cannot expect the effectiveness. Since the effectiveness that Ag addition improves a fall and mechanical property of melting temperature in 2.5 mass % from 1.5 mass % is seen, it is the most desirable.
[0010] Addition of Bi lowers the melting temperature of solder, prevents the thermal damage on components or a printed circuit board, and is effective in improving the mechanical property after soldering further. However, under by 0.5 mass %, the effectiveness has inadequate Bi addition and, on the other hand, it becomes it is hard and weak at 10.0 mass % **.
[0011] Addition of Cu makes an organization make it detailed more, and is effective in improving a mechanical property further. However, under 0.1 mass % of the effectiveness is [Cu addition] inadequate, and, on the other hand, it reduces a mechanical property by the rise of melting temperature, and big and rough-ization of the crystalline structure by 1.0 mass % **. Since the effectiveness that Cu addition makes an organization make it detailed more in 0.8 mass % from 0.5 mass %, and improves a mechanical property further is seen, it is the most desirable.
[0012] Addition of P is effective in improving antioxidizing and a mechanical property. However, under 0.001 mass % of the effectiveness is [P addition] inadequate, and, on the other hand, it reduces a mechanical property by 0.01 mass % **. Since the effectiveness that P addition improves the antioxidizing effectiveness and a mechanical property in 0.004 to 0.006 mass % is seen, it is the most desirable.

[0013] Although nickel addition makes a solder organization make it detailed more and a mechanical property is made to improve further, under 0.001 mass % of the effectiveness is [nickel addition] inadequate, and, on the other hand, it skyrockets melting temperature by 0.01 mass % **. Since the effectiveness that nickel addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0014] In the solder presentation of the 2nd invention, although germanium addition makes a solder organization make it detailed more and a mechanical property is made to improve further, under 0.005 mass % of the effectiveness is [germanium addition] inadequate, and, on the other hand, it skyrockets melting temperature by 0.05 mass % **. Since the effectiveness that germanium addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.008 to 0.012 mass % is seen, it is the most desirable.
[0015] Having added Te and Ga aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more, and antioxidizing in the solder presentation of the 3rd invention. However, under 0.001 mass % of the effectiveness is [Te addition] inadequate, and, on the other hand, melting temperature rises by 0.001 mass % **. Under 0.01 mass % of the effectiveness is [Ga addition] inadequate, and, on the other hand, melting temperature rises by 0.1 mass % **. In 0.001 to 0.005 mass %, since make a solder organization make it detailed more, a mechanical property is made to improve further and the antioxidizing effectiveness is also seen, Te addition is the most desirable. In 0.01 to 0.05 mass %, since make a solder organization make it detailed more, a mechanical property is made to improve further and the antioxidizing effectiveness is also seen, Ga addition is the most desirable.
[0016] Having added Co aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more in the solder presentation of the 4th invention. However, under 0.001 mass % of the effectiveness is [Co addition] inadequate, and, on the other hand, melting temperature rises by 0.01 mass % **. Since the effectiveness that Co addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0017] Having added Cr aims at aiming at detailed-izing of an organization, and an improvement of a mechanical property more in the solder presentation of the 5th invention. However, under 0.005 mass % of the effectiveness is [Cr addition] inadequate, and, on the other hand, melting temperature rises by 0.05 mass % **. Since the effectiveness that Cr addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.01 to 0.02 mass % is seen, it is the most desirable.
[0018] In the solder presentation of the 6th invention, having added Co further to the solder presentation of the 5th invention aims at heightening more the effectiveness which makes detailed the solder organization which Cr has, and the effectiveness which a mechanical property improves. However, under 0.001 mass % of the effectiveness is [Co addition] inadequate, and, on the other hand, melting temperature rises by 0.01 mass % **. Since the effectiveness that Co addition makes a solder organization make it detailed more, and makes a mechanical property improve further in 0.004 to 0.006 mass % is seen, it is the most desirable.
[0019]
[Embodiment of the Invention] As an example, Table 1 (example No.1-01-1-24), Table 2 (example No.2-01-2-24), The solder of the presentation shown in Table 3 (example No.3-01-3-24), Table 4 (example No.4-01-4-24), Table 5 (example No.5-01-5-24), and Table 6 (example No.6-01-6-24) was manufactured.
[0020] The figure which shows the presentation rate in Table 6 from Table 1 shows mass %, and melting temperature shows (solidus-line temperature - liquidus-line temperature).
[0021]
[Table 1]

表1. 実施例

No.	Sn	Ag	Bi	Cu	P	Ni	溶融温度℃
1-01	残部	0.5	0.5	0.1	0.001	0.001	217 ～232
1-02	残部	0.5	1.0	0.1	0.001	0.001	212 ～227
1-03	残部	0.5	2.0	0.1	0.001	0.001	209 ～222
1-04	残部	0.5	5.0	0.1	0.001	0.001	201 ～218
1-05	残部	0.5	8.0	0.1	0.001	0.001	192 ～214
1-06	残部	0.5	10.0	0.1	0.001	0.001	178 ～206
1-07	残部	1.0	0.5	0.4	0.004	0.004	218 ～232
1-08	残部	1.0	1.0	0.4	0.004	0.004	213 ～227
1-09	残部	1.0	2.0	0.4	0.004	0.004	210 ～222
1-10	残部	1.0	5.0	0.4	0.004	0.004	203 ～218
1-11	残部	1.0	8.0	0.4	0.004	0.004	194 ～214
1-12	残部	1.0	10.0	0.4	0.004	0.004	178 ～208
1-13	残部	2.0	0.5	0.6	0.006	0.006	218 ～232
1-14	残部	2.0	1.0	0.6	0.006	0.006	214 ～227
1-15	残部	2.0	2.0	0.6	0.006	0.006	210 ～222
1-16	残部	2.0	5.0	0.6	0.006	0.006	203 ～218
1-17	残部	2.0	8.0	0.6	0.006	0.006	194 ～215
1-18	残部	2.0	10.0	0.6	0.006	0.006	179 ～207
1-19	残部	3.5	0.5	1.0	0.01	0.01	219 ～232
1-20	残部	3.5	1.0	1.0	0.01	0.01	214 ～227
1-21	残部	3.5	2.0	1.0	0.01	0.01	211 ～222
1-22	残部	3.5	5.0	1.0	0.01	0.01	205 ～219
1-23	残部	3.5	8.0	1.0	0.01	0.01	194 ～215
1-24	残部	3.5	10.0	1.0	0.01	0.01	179 ～208

[0022]
[Table 2]

表2．実施例

No.	Sn	Ag	Bi	Cu	P	Ge	溶融温度℃
2-01	残部	0.5	0.5	0.1	0.001	0.005	217 ～232
2-02	残部	0.5	1.0	0.1	0.001	0.005	212 ～227
2-03	残部	0.5	2.0	0.1	0.001	0.005	209 ～222
2-04	残部	0.5	5.0	0.1	0.001	0.005	201 ～218
2-05	残部	0.5	8.0	0.1	0.001	0.005	192 ～214
2-06	残部	0.5	10.0	0.1	0.001	0.005	178 ～206
2-07	残部	1.0	0.5	0.4	0.004	0.008	218 ～232
2-08	残部	1.0	1.0	0.4	0.004	0.008	213 ～227
2-09	残部	1.0	2.0	0.4	0.004	0.008	210 ～222
2-10	残部	1.0	5.0	0.4	0.004	0.008	203 ～218
2-11	残部	1.0	8.0	0.4	0.004	0.008	194 ～214
2-12	残部	1.0	10.0	0.4	0.004	0.008	178 ～208
2-13	残部	2.0	0.5	0.6	0.006	0.012	218 ～232
2-14	残部	2.0	1.0	0.6	0.006	0.012	215 ～227
2-15	残部	2.0	2.0	0.6	0.006	0.012	210 ～223
2-16	残部	2.0	5.0	0.6	0.006	0.012	204 ～219
2-17	残部	2.0	8.0	0.6	0.006	0.012	194 ～215
2-18	残部	2.0	10.0	0.6	0.006	0.012	179 ～207
2-19	残部	3.5	0.5	1.0	0.01	0.05	219 ～232
2-20	残部	3.5	1.0	1.0	0.01	0.05	215 ～228
2-21	残部	3.5	2.0	1.0	0.01	0.05	211 ～224
2-22	残部	3.5	5.0	1.0	0.01	0.05	205 ～219
2-23	残部	3.5	8.0	1.0	0.01	0.05	194 ～215
2-24	残部	3.5	10.0	1.0	0.01	0.05	179 ～208

[0023]
[Table 3]

表3. 実施例

No.	Sn	Ag	Bi	Cu	P	Te	Ga	溶融温度℃
3-01	残部	0.5	0.5	0.1	0.001	0.001	0.01	217 ~232
3-02	残部	0.5	1.0	0.1	0.001	0.001	0.01	212 ~227
3-03	残部	0.5	2.0	0.1	0.001	0.001	0.01	209 ~222
3-04	残部	0.5	5.0	0.1	0.001	0.001	0.01	201 ~218
3-05	残部	0.5	8.0	0.1	0.001	0.001	0.01	192 ~214
3-06	残部	0.5	10.0	0.1	0.001	0.001	0.01	178 ~206
3-07	残部	1.0	0.5	0.4	0.004	0.004	0.04	218 ~232
3-08	残部	1.0	1.0	0.4	0.004	0.004	0.04	213 ~227
3-09	残部	1.0	2.0	0.4	0.004	0.004	0.04	210 ~222
3-10	残部	1.0	5.0	0.4	0.004	0.004	0.04	203 ~218
3-11	残部	1.0	8.0	0.4	0.004	0.004	0.04	194 ~214
3-12	残部	1.0	10.0	0.4	0.004	0.004	0.04	178 ~208
3-13	残部	2.0	0.5	0.6	0.006	0.006	0.06	218 ~232
3-14	残部	2.0	1.0	0.6	0.006	0.006	0.06	215 ~227
3-15	残部	2.0	2.0	0.6	0.006	0.006	0.06	210 ~223
3-16	残部	2.0	5.0	0.6	0.006	0.006	0.06	204 ~219
3-17	残部	2.0	8.0	0.6	0.006	0.006	0.06	194 ~215
3-18	残部	2.0	10.0	0.6	0.006	0.006	0.06	179 ~207
3-19	残部	3.5	0.5	1.0	0.01	0.01	0.1	219 ~232
3-20	残部	3.5	1.0	1.0	0.01	0.01	0.1	215 ~228
3-21	残部	3.5	2.0	1.0	0.01	0.01	0.1	211 ~224
3-22	残部	3.5	5.0	1.0	0.01	0.01	0.1	205 ~219
3-23	残部	3.5	8.0	1.0	0.01	0.01	0.1	194 ~215
3-24	残部	3.5	10.0	1.0	0.01	0.01	0.1	179 ~208

[0024]
[Table 4]

表4. 実施例

No.	Sn	Ag	Bi	Cu	P	Co	溶融温度℃
4-01	残部	0.5	0.5	0.1	0.001	0.001	217 ～232
4-02	残部	0.5	1.0	0.1	0.001	0.001	212 ～227
4-03	残部	0.5	2.0	0.1	0.001	0.001	209 ～222
4-04	残部	0.5	5.0	0.1	0.001	0.001	201 ～218
4-05	残部	0.5	8.0	0.1	0.001	0.001	192 ～214
4-06	残部	0.5	10.0	0.1	0.001	0.001	178 ～206
4-07	残部	1.0	0.5	0.4	0.004	0.004	218 ～232
4-08	残部	1.0	1.0	0.4	0.004	0.004	213 ～227
4-09	残部	1.0	2.0	0.4	0.004	0.004	210 ～222
4-10	残部	1.0	5.0	0.4	0.004	0.004	203 ～218
4-11	残部	1.0	8.0	0.4	0.004	0.004	194 ～214
4-12	残部	1.0	10.0	0.4	0.004	0.004	178 ～208
4-13	残部	2.0	0.5	0.6	0.006	0.006	218 ～232
4-14	残部	2.0	1.0	0.6	0.006	0.006	215 ～227
4-15	残部	2.0	2.0	0.6	0.006	0.006	210 ～223
4-16	残部	2.0	5.0	0.6	0.006	0.006	204 ～219
4-17	残部	2.0	8.0	0.6	0.006	0.006	194 ～215
4-18	残部	2.0	10.0	0.6	0.006	0.006	179 ～207
4-19	残部	3.5	0.5	1.0	0.01	0.01	219 ～232
4-20	残部	3.5	1.0	1.0	0.01	0.01	215 ～228
4-21	残部	3.5	2.0	1.0	0.01	0.01	211 ～224
4-22	残部	3.5	5.0	1.0	0.01	0.01	205 ～219
4-23	残部	3.5	8.0	1.0	0.01	0.01	194 ～215
4-24	残部	3.5	10.0	1.0	0.01	0.01	179 ～208

[0025]
[Table 5]

表5．実施例

No.	Sn	Ag	Bi	Cu	P	Cr	溶融温度℃
5-01	残部	0.5	0.5	0.1	0.001	0.005	217 ~232
5-02	残部	0.5	1.0	0.1	0.001	0.005	212 ~227
5-03	残部	0.5	2.0	0.1	0.001	0.005	209 ~222
5-04	残部	0.5	5.0	0.1	0.001	0.005	201 ~218
5-05	残部	0.5	8.0	0.1	0.001	0.005	192 ~214
5-06	残部	0.5	10.0	0.1	0.001	0.005	178 ~206
5-07	残部	1.0	0.5	0.4	0.004	0.01	218 ~232
5-08	残部	1.0	1.0	0.4	0.004	0.01	213 ~227
5-09	残部	1.0	2.0	0.4	0.004	0.01	210 ~222
5-10	残部	1.0	5.0	0.4	0.004	0.01	203 ~218
5-11	残部	1.0	8.0	0.4	0.004	0.01	194 ~214
5-12	残部	1.0	10.0	0.4	0.004	0.01	178 ~208
5-13	残部	2.0	0.5	0.6	0.006	0.02	218 ~232
5-14	残部	2.0	1.0	0.6	0.006	0.02	215 ~227
5-15	残部	2.0	2.0	0.6	0.006	0.02	210 ~223
5-16	残部	2.0	5.0	0.6	0.006	0.02	204 ~219
5-17	残部	2.0	8.0	0.6	0.006	0.02	194 ~215
5-18	残部	2.0	10.0	0.6	0.006	0.02	179 ~207
5-19	残部	3.5	0.5	1.0	0.01	0.05	219 ~232
5-20	残部	3.5	1.0	1.0	0.01	0.05	215 ~228
5-21	残部	3.5	2.0	1.0	0.01	0.05	211 ~224
5-22	残部	3.5	5.0	1.0	0.01	0.05	205 ~219
5-23	残部	3.5	8.0	1.0	0.01	0.05	194 ~215
5-24	残部	3.5	10.0	1.0	0.01	0.05	179 ~208

[0026]
[Table 6]

表6．実施例

No.	Sn	Ag	Bi	Cu	P	Cr	Co	溶融温度℃
6-01	残部	0.5	0.5	0.1	0.001	0.005	0.001	217 ～232
6-02	残部	0.5	1.0	0.1	0.001	0.005	0.001	212 ～227
6-03	残部	0.5	2.0	0.1	0.001	0.005	0.001	209 ～222
6-04	残部	0.5	5.0	0.1	0.001	0.005	0.001	201 ～218
6-05	残部	0.5	8.0	0.1	0.001	0.005	0.001	192 ～214
6-06	残部	0.5	10.0	0.1	0.001	0.005	0.001	178 ～206
6-07	残部	1.0	0.5	0.4	0.004	0.01	0.004	218 ～232
6-08	残部	1.0	1.0	0.4	0.004	0.01	0.004	213 ～227
6-09	残部	1.0	2.0	0.4	0.004	0.01	0.004	210 ～222
6-10	残部	1.0	5.0	0.4	0.004	0.01	0.004	203 ～218
6-11	残部	1.0	8.0	0.4	0.004	0.01	0.004	194 ～214
6-12	残部	1.0	10.0	0.4	0.004	0.01	0.004	178 ～208
6-13	残部	2.0	0.5	0.6	0.006	0.02	0.006	218 ～232
6-14	残部	2.0	1.0	0.6	0.006	0.02	0.006	215 ～227
6-15	残部	2.0	2.0	0.6	0.006	0.02	0.006	210 ～223
6-16	残部	2.0	5.0	0.6	0.006	0.02	0.006	204 ～218
6-17	残部	2.0	8.0	0.6	0.006	0.02	0.006	194 ～215
6-18	残部	2.0	10.0	0.6	0.006	0.02	0.006	179 ～207
6-19	残部	3.5	0.5	1.0	0.01	0.05	0.01	219 ～232
6-20	残部	3.5	1.0	1.0	0.01	0.05	0.01	215 ～228
6-21	残部	3.5	2.0	1.0	0.01	0.05	0.01	211 ～223
6-22	残部	3.5	5.0	1.0	0.01	0.05	0.01	205 ～218
6-23	残部	3.5	8.0	1.0	0.01	0.05	0.01	194 ～215
6-24	残部	3.5	10.0	1.0	0.01	0.05	0.01	179 ～208

[0027] The solder (example No.of comparison1-5) of the presentation shown in Table 7 was manufactured as an example of a comparison for comparing with the above and an example, and the melting temperature was measured.

[0028]

[Table 7]

表7．比較例

No.	Sn	Ag	Bi	Cu	溶融温度（℃）
1	残部	3.5	—	—	221～229
2	残部	1.5	5.0	—	205～219
3	残部	1.5	—	1.0	217～222
4	残部	1.5	5.0	1.0	201～218
5	残部	2.0	7.5	0.5	177～209

[0029] About the above, the example, and the example of a comparison, it fell at the time of the tensile test at the time of ordinary temperature (measurement 1), the tensile test at the time of an elevated temperature (measurement 2), the creep test (measurement 3) by the fracture timing measurement at the time of ordinary temperature, and an elevated temperature out, and Young's modulus (measurement 5) at the time of timing measurement (measurement 4) and ordinary temperature was measured.
[0030] The measurement result of the example of a comparison is shown in Table 8, and the measurement result of an example is shown in Tables 9-14. in addition, the unit of tensile strength -- the unit of kgf/mm2 and elongation -- the unit of %, fracture time amount, and gradation time amount -- time amount (Hr) and Young's modulus -- kN/mm2 it is .
[0031]
[Table 8]

表8．比較例の測定結果

評価 / No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
1	6.7	27.4	4.8	25.3	9200以上	6600以上	40.2
2	7.6	15.3	5.3	14.5	9200以上	6600以上	37.8
3	5.5	27.4	3.9	29.4	9200以上	6600以上	41.3
4	8.4	16.7	5.8	15.8	9200以上	6600以上	38.7
5	8.3	13.2	5.5	14.8	8300	6600以上	41.6

[0032]
[Table 9]

表9．実施例NO．1－01～1－24のはんだ合金の特性比較データ

評価 / No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
1-01	7.2	16.7	5.7	15.6	9200以上	6600以上	38.2
1-02	7.3	15.3	5.9	14.2	9200以上	6600以上	37.8
1-03	7.7	15.4	6.1	13.8	9200以上	6600以上	37.4
1-04	7.9	14.2	6.4	12.1	9200以上	6600以上	36.7
1-05	8.4	13.8	6.7	11.8	9200以上	6600以上	35.9
1-06	8.8	12.4	6.9	10.2	9200以上	6600以上	35.1
1-07	7.3	16.3	5.9	16.1	9200以上	6600以上	39.0
1-08	7.5	15.7	6.2	15.0	9200以上	6600以上	38.6
1-09	7.8	14.3	6.4	14.1	9200以上	6600以上	37.5
1-10	8.1	13.5	6.6	13.0	9200以上	6600以上	36.7
1-11	8.4	12.6	6.9	12.3	9200以上	6600以上	36.1
1-12	8.9	11.8	7.2	10.9	9200以上	6600以上	35.5
1-13	7.4	15.4	5.8	15.8	9200以上	6600以上	39.1
1-14	7.6	14.7	6.2	14.4	9200以上	6600以上	38.6
1-15	7.8	14.1	6.4	13.5	9200以上	6600以上	37.8
1-16	8.3	13.7	6.9	12.5	9200以上	6600以上	37.1
1-17	8.5	12.2	7.0	11.9	9200以上	6600以上	36.5
1-18	9.2	11.0	7.3	10.4	9200以上	6600以上	36.0
1-19	7.5	15.9	5.5	15.2	9200以上	6600以上	38.4
1-20	7.9	14.3	5.7	14.0	9200以上	6600以上	37.5
1-21	8.4	13.4	5.9	13.3	9200以上	6600以上	37.3
1-22	8.9	12.2	6.0	12.1	9200以上	6600以上	36.6
1-23	9.2	11.8	6.8	11.3	9200以上	6600以上	35.5
1-24	9.5	10.8	7.0	10.2	9200以上	6600以上	35.0

[0033]
[Table 10]

表１０．実施例NO．２－０１～２－２４のはんだ合金の特性比較データ

評価 No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
2-01	7.3	16.6	5.5	15.2	9200以上	6600以上	38.5
2-02	7.5	15.1	5.6	14.0	9200以上	6600以上	37.9
2-03	7.8	14.7	5.9	13.4	9200以上	6600以上	37.3
2-04	8.1	13.9	6.2	11.9	9200以上	6600以上	36.8
2-05	8.6	13.5	6.6	11.6	9200以上	6600以上	35.6
2-06	9.0	12.0	6.8	10.5	9200以上	6600以上	34.9
2-07	7.1	16.5	5.6	15.4	9200以上	6600以上	37.8
2-08	7.3	15.0	6.1	14.0	9200以上	6600以上	36.9
2-09	7.5	14.8	6.3	13.6	9200以上	6600以上	37.0
2-10	8.0	14.1	6.8	11.8	9200以上	6600以上	36.5
2-11	8.3	13.7	7.1	11.2	9200以上	6600以上	36.3
2-12	8.7	12.2	7.3	10.0	9200以上	6600以上	35.6
2-13	7.4	16.4	5.7	15.6	9200以上	6600以上	38.1
2-14	7.7	15.4	5.9	14.2	9200以上	6600以上	37.3
2-15	8.0	14.9	6.1	13.8	9200以上	6600以上	36.8
2-16	7.9	13.7	6.4	12.1	9200以上	6600以上	36.5
2-17	8.5	12.9	6.7	11.8	9200以上	6600以上	36.2
2-18	8.7	11.8	6.9	10.2	9200以上	6600以上	35.4
2-19	7.3	15.9	5.7	15.2	9200以上	6600以上	38.2
2-20	7.6	14.2	5.9	14.4	9200以上	6600以上	37.6
2-21	8.0	13.5	6.1	13.7	9200以上	6600以上	37.3
2-22	8.0	12.2	6.4	12.3	9200以上	6600以上	36.8
2-23	8.7	11.5	6.7	11.2	9200以上	6600以上	36.0
2-24	9.1	10.5	6.9	9.9	9200以上	6600以上	35.3

[0034]
[Table 11]

表１１．実施例NO．３－０１～３－２４のはんだ合金の特性比較データ

評価	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
No.	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
3-01	7.1	16.6	5.5	15.3	9200以上	6600以上	38.4
3-02	7.4	15.3	5.8	14.1	9200以上	6600以上	37.6
3-03	7.9	14.6	6.0	12.9	9200以上	6600以上	37.2
3-04	8.2	14.0	6.3	11.8	9200以上	6600以上	36.9
3-05	8.8	13.7	6.9	11.4	9200以上	6600以上	36.1
3-06	9.1	12.2	7.0	10.8	9200以上	6600以上	35.8
3-07	7.0	16.3	5.9	15.2	9200以上	6600以上	37.8
3-08	7.4	14.9	6.2	14.1	9200以上	6600以上	37.4
3-09	7.7	14.6	6.5	13.4	9200以上	6600以上	37.0
3-10	8.1	14.0	6.9	11.7	9200以上	6600以上	36.9
3-11	8.4	13.8	7.1	11.4	9200以上	6600以上	36.0
3-12	8.9	12.3	7.2	10.3	9200以上	6600以上	35.6
3-13	7.5	16.1	5.3	15.4	9200以上	6600以上	38.4
3-14	7.8	15.7	5.6	14.0	9200以上	6600以上	37.9
3-15	8.2	14.9	6.0	13.7	9200以上	6600以上	37.1
3-16	8.3	13.9	6.2	12.0	9200以上	6600以上	36.6
3-17	8.7	13.2	6.6	11.6	9200以上	6600以上	35.9
3-18	9.1	12.1	6.9	10.4	9200以上	6600以上	35.7
3-19	7.1	15.1	5.7	14.7	9200以上	6600以上	37.6
3-20	7.4	14.0	5.9	13.8	9200以上	6600以上	37.1
3-21	7.7	13.3	6.1	12.9	9200以上	6600以上	36.8
3-22	8.1	12.0	6.4	11.5	9200以上	6600以上	35.8
3-23	8.8	11.1	6.7	10.8	9200以上	6600以上	34.9
3-24	9.3	10.0	6.8	9.7	9200以上	6600以上	34.7

[0035]
[Table 12]

表12. 実施例NO. 4－01～4－24のはんだ合金の特性比較データ

評価	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
No.	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
4-01	7.4	16.9	5.2	15.0	9200以上	6600以上	37.9
4-02	7.5	15.0	5.7	13.7	9200以上	6600以上	36.6
4-03	7.8	14.4	6.1	12.6	9200以上	6600以上	36.2
4-04	8.0	13.9	6.5	11.9	9200以上	6600以上	36.0
4-05	8.6	13.6	6.8	11.2	9200以上	6600以上	35.8
4-06	8.8	12.5	7.1	10.7	9200以上	6600以上	35.4
4-07	7.1	16.1	5.6	15.3	9200以上	6600以上	38.1
4-08	7.3	15.7	6.0	14.5	9200以上	6600以上	37.6
4-09	7.8	14.5	6.3	13.0	9200以上	6600以上	37.5
4-10	8.3	13.8	6.7	12.1	9200以上	6600以上	36.9
4-11	8.6	12.7	7.0	11.5	9200以上	6600以上	36.0
4-12	9.1	11.9	7.3	10.1	9200以上	6600以上	35.6
4-13	7.4	16.3	5.2	15.3	9200以上	6600以上	38.0
4-14	7.7	15.5	5.4	14.1	9200以上	6600以上	37.6
4-15	8.3	14.6	5.7	13.9	9200以上	6600以上	37.3
4-16	8.4	13.5	6.0	12.3	9200以上	6600以上	36.9
4-17	8.6	12.8	6.4	11.8	9200以上	6600以上	35.6
4-18	9.0	11.4	6.8	10.2	9200以上	6600以上	35.0
4-19	7.0	15.1	5.5	14.5	9200以上	6600以上	38.6
4-20	7.1	14.3	5.9	13.5	9200以上	6600以上	37.5
4-21	7.4	13.2	6.1	12.7	9200以上	6600以上	37.3
4-22	8.3	11.8	6.2	11.4	9200以上	6600以上	36.6
4-23	8.9	10.3	6.4	10.3	9200以上	6600以上	36.1
4-24	9.2	9.8	6.6	9.8	9200以上	6600以上	35.4

[0036]
[Table 13]

表１３．実施例NO．５－０１～５－２４のはんだ合金の特性比較データ

評価 No.	測定条件１		測定条件２		測定条件３	測定条件４	測定条件５
	引張強度	伸　び	引張強度	伸　び	破断時間	抜落ち時間	ヤング率
5-01	7.3	16.8	5.4	15.3	9200以上	6600以上	38.1
5-02	7.4	15.2	5.8	14.1	9200以上	6600以上	37.4
5-03	7.6	14.5	6.1	13.8	9200以上	6600以上	36.9
5-04	7.9	13.7	6.4	12.5	9200以上	6600以上	36.2
5-05	8.3	13.3	7.1	11.4	9200以上	6600以上	35.4
5-06	8.7	12.4	7.4	10.9	9200以上	6600以上	35.2
5-07	7.3	16.3	5.8	15.1	9200以上	6600以上	37.9
5-08	7.5	15.6	6.0	14.3	9200以上	6600以上	37.5
5-09	7.9	14.3	6.2	12.8	9200以上	6600以上	37.3
5-10	8.2	13.6	6.5	12.3	9200以上	6600以上	37.0
5-11	8.5	12.4	6.9	11.2	9200以上	6600以上	36.5
5-12	9.0	11.7	7.2	10.4	9200以上	6600以上	35.8
5-13	7.3	16.0	5.7	15.7	9200以上	6600以上	38.7
5-14	7.6	15.2	6.2	14.0	9200以上	6600以上	37.9
5-15	8.1	14.5	6.7	13.6	9200以上	6600以上	37.4
5-16	8.3	13.4	7.0	12.4	9200以上	6600以上	37.0
5-17	8.8	12.5	7.3	11.6	9200以上	6600以上	36.0
5-18	9.3	11.0	7.7	10.1	9200以上	6600以上	35.3
5-19	7.2	15.3	5.6	14.3	9200以上	6600以上	38.3
5-20	7.3	14.2	6.0	13.4	9200以上	6600以上	37.7
5-21	7.6	13.5	6.2	12.8	9200以上	6600以上	37.4
5-22	8.1	12.0	6.4	11.2	9200以上	6600以上	36.5
5-23	8.4	11.2	6.7	10.6	9200以上	6600以上	36.0
5-24	8.9	9.9	6.8	10.2	9200以上	6600以上	35.6

[0037]
[Table 14]

表14. 実施例NO. 6－01～6－24のはんだ合金の特性比較データ

評価 / No.	測定条件1		測定条件2		測定条件3	測定条件4	測定条件5
	引張強度	伸び	引張強度	伸び	破断時間	抜落ち時間	ヤング率
6-01	7.2	16.6	5.6	15.1	9200以上	6600以上	38.2
6-02	7.5	15.1	5.9	14.3	9200以上	6600以上	37.3
6-03	7.8	14.6	6.2	13.5	9200以上	6600以上	36.8
6-04	8.1	13.6	6.6	12.7	9200以上	6600以上	36.3
6-05	8.5	13.1	7.0	11.8	9200以上	6600以上	35.9
6-06	8.9	12.2	7.2	10.6	9200以上	6600以上	35.5
6-07	7.2	15.9	5.4	15.0	9200以上	6600以上	38.3
6-08	7.7	15.5	5.8	14.7	9200以上	6600以上	37.8
6-09	8.0	14.7	6.1	13.2	9200以上	6600以上	37.3
6-10	8.3	13.9	6.4	12.7	9200以上	6600以上	36.8
6-11	8.4	12.5	6.7	11.5	9200以上	6600以上	36.3
6-12	8.8	11.8	7.0	10.8	9200以上	6600以上	35.7
6-13	7.5	15.9	5.4	15.7	9200以上	6600以上	37.9
6-14	7.7	15.0	5.9	14.3	9200以上	6600以上	37.5
6-15	8.3	14.7	6.4	13.8	9200以上	6600以上	37.4
6-16	8.7	13.6	6.8	12.1	9200以上	6600以上	36.7
6-17	9.1	12.2	7.0	11.8	9200以上	6600以上	35.8
6-18	9.5	10.9	7.4	10.5	9200以上	6600以上	35.3
6-19	7.1	15.3	4.8	14.1	9200以上	6600以上	37.6
6-20	7.5	14.1	5.1	13.0	9200以上	6600以上	36.9
6-21	7.9	13.0	5.5	12.2	9200以上	6600以上	36.4
6-22	8.2	11.6	5.8	11.1	9200以上	6600以上	35.9
6-23	8.6	10.5	6.3	10.4	9200以上	6600以上	35.2
6-24	9.1	9.8	6.8	9.3	9200以上	6600以上	34.7

[0038] The Measuring condition of measurement 1 - measurement 4 is as being shown below.
[0039]
Measurement 1: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Ordinary temperature (25 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: ** tensile strength (Kgf/mm2) ** growth ** (%) Measurement 2: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Elevated temperature (100 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: ** tensile strength (Kgf/mm2) ** growth ** (%) Measurement 3: Equipment: The equipment and the test piece which are shown in drawing 1 Temperature: Ordinary temperature (25 degrees C)
Load: 15kg (7.5N/mm2) [Creep resistance]
Time amount until it evaluates : fractures (Hr.)
Test method: ******** formed like drawing 1 in ordinary temperature (25 degrees C) It is 2 7.5 N/mm to a golden test piece. A load is added and it is to fracture. Time amount was measured.
[0040]
Measurement 4: Equipment: Equipment shown in drawing 2 Temperature: Elevated temperature (100 degrees C)
Load: 1kg [creep resistance]
Evaluation: Time amount until copper wire falls out (Hr.)

Test method: He is one side covellite Dos like drawing 2 at an elevated temperature (100 degrees C). It is 55mg about copper wire with a diameter of 1mm to a roux hole substrate. It solders with solder and is 1Kgf caudad. It is ** about a load. It obtained and the time amount to fracture was measured.
[0041]
Measurement 5: Equipment: Tension tester (Shimadzu trade name: autograph)
Temperature: Ordinary temperature (25 degrees C)
Speed of testing: 10 (mm/min.)
Evaluation: It asks for Young's modulus from tensile strength and elongation.
[0042] Elongation was low although, as for the example, the inclination for tensile strength to be high was accepted in the tensile test at the time of ordinary temperature (measurement 1) as compared with the example of a comparison as a result of measurement.
[0043] In the tensile test (measurement 2) at the time of an elevated temperature (100 degrees C), although it was admitted that the tensile strength of an example was fully high to the example of a comparison, elongation was low.
[0044] it was admitted that creep resistance boiled especially the above-mentioned example markedly to the example of a comparison in the creep test (measurement 3) by the fracture timing measurement at the time of ordinary temperature, and it excelled.
[0045] Furthermore, it was admitted that it fell at the time of an elevated temperature out, and the above-mentioned example was extremely excellent in the bonding strength of the soldering section at the time of an elevated temperature to the example of a comparison in a timing measurement trial (measurement 4).
[0046] The solder of this invention is usable also about what can use with the gestalt of a rod, a wire, a ribbon, preforming, solder powder, etc., and contains flux.

[Translation done.]

* NOTICES *

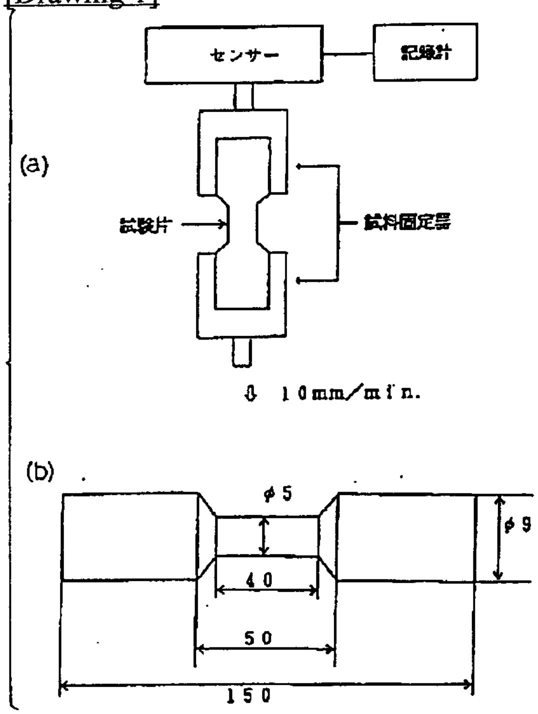
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing in which the equipment and the test piece which are used for the creep test by the fracture timing measurement at the time of ordinary temperature are shown, (a) shows equipment and (b) shows a test piece, respectively.
[Drawing 2] Drawing showing the equipment which it falls at the time of an elevated temperature out, and is used for a timing measurement trial.

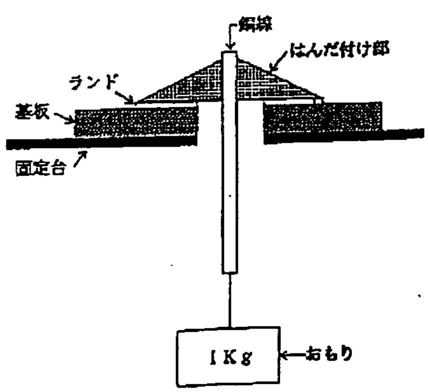
[Translation done.]

DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]